An Essay
On
The Causes, Phenomena And Termination of Inflammation

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Inflammation being one of the most important of the many diseased conditions which the physician is called upon to diagnose and treat, and forming as it does an essential part in most diseases, and in many instances constituting the great source of danger, has been chosen the subject of the following essay.

The causes of inflammation may be divided into predisposing and exciting. The predisposing causes are constitutional

predispositions which render the body liable to inflammations as those causes which affect the vascular system either from the result of original conformation as in the sanguine temperament where the system is active, and circulates red blood, which contains a large proportion of red particles, as is shown by the excitable pulse and flushing cheek of those who possess this temperament, or where it has been the effects of previous disease, or by external or internal causes which at the time tend generally

or locally to impair the healthy tone & equilibrium of the vascular system. Hence we find persons of the inflammatory diathesis to be those whose circulation has been either weakened or excited by previous disease, fatigue, impure air, confinement or poor and improper nourishment.

The exciting causes of inflammation are properly divided into those which act locally on the part which becomes inflamed and those which act more generally on other

parts. The causes which excite inflammation locally include mechanical irritations as a foreign body in the eye, wounds or bruises in the flesh, chemical irritants as those which act upon living matter by chemical affinity, combining with and destroying it. These chemical causes are more varied than the mechanical, because chemical agents are more numerous and as we are better acquainted with the mechanism than with the chemistry of the animal body, we are less able to distin-

guish causes which act by chemical properties. But we readily recognize chemical irritants in acids, and in alkalies, and many salts which are found by the combination of the two, so what are called chemical poisons are irritants, such as Corrosive Sublimate and numerous other metallic salts, and the strong acids, and alkalies, Chlorine, Iodine, &c act as local exciting causes by their known powerful chemical affinities, which tend to decompose tissue and disorder the functions.

Amongst the local exciting

causes may also be enumerated what are termed Vital irritants, these are various agents as Canthurides, Capsicum, Mus. lard and essential oils whose irritating properties are not referable to any known chemical property which they possess. Inflammation is sometimes caused by the retention of excrementitious matter in the blood, where the functions of some of the excreting organs are impaired. Thus when urea is retained in the blood in consequence of the kidneys failing to perform their proper

functions. In large quantities it acts on the nervous system as a narcotic poison. In smaller amounts it acts as an irritant inducing low inflammation in various membranes and viscera.

Local inflammation are often produced by poisons which have been received into the system, thus the poison of small pox, measles and scarlatina, inflame the throat, skin, and air passages, and arsnic when ever applied to a wound causes inflamation of the

stomach and intestines.
It apears in these cases that
the inflammation is ex-
cited by the presence of the irri-
tating matter which is carried
by the blood to the parts which
become
~~are~~ inflamed.

The class of exciting
causes which operate entirely
in producing inflammatory
action, are of common occur-
ance. Most of those causes first
produce congestion which is
converted by the occurance
of subsequent reaction
into inflammation.
Cold is a common cause
which chiefly operates by

constricting the vessels of the surface and extremities thus causing internal congestion by the blood being driven from the surface to internal organs. If this state of congestion exists for a long time the tone of the vessels will become weakened or impaired and the congestion will not generally cease on the warmth of the surface being restored, and thus a permanent congestion of the lungs, liver, kidneys, mucous and serous membranes are often produced and may disorder the functions

of the part, or which is more often the case, lay the foundation for inflammatory action

Malaria and those influences which produce the continued & exanthematous fevers, seem to be similar in their effects to those produced by external cold but it is more difficult to explain their mode of operation. But it is well known during the cold stages of these diseases, that the liver and spleen are congested and enlarged, and that inflammatory action are apt to spring up by these con-

-gestions remain during the
febrile stages of the disease.
The suppression of natural
or habitual discharges, the
sudden drying up of ulcers,
the congestion of the lungs,
brain, and mucous mem-
-branes which result from
various asphyxiating causes
and the repulsion of cutane-
-ous eruptions, are recognized
as being amongst the vari-
ous causes of inflamation.

The symptoms of in-
flamation are divided
into local and constitutional
The local phenomena which
from the time of Celsus

have been considered distinctive of inflammation are redness, heat, pain and swelling.

Redness is usually the first observable phenomena and as every one is familiar with the natural character of the external portion of the body, the change of colour following inflammatory action has long been regarded as one of the most prominent signs of its presence. In order for redness to be characteristic of inflammation it must be of a tint which is above the natural stand-

of colour. It may be of various intensity and shade, according to the degree of the inflammation its stages, the part effected, the state of the system, and the nature of the cause. It is found of every grade from a light rose color to a deep crimson, or purple. In acute inflamation it is generally of a bright scarlet, but in chronic, it is often of a more purple hue. The color is most generally marked at one spot the focus and decreases or shades off to the healthy tint as it departs from the centre, but sometimes it

has an abrupt boundary, and is of equal intensity throughout — In other instances as in Erysipelatous inflammation it is irregular or even fringed and indented on its margin. The pressure of the finger on the inflamed part often destroys the red color and renders the part pressed upon momentarily paler than natural, but when the pressure is removed the redness is rapidly restored thus showing a good test of the activity of the circulation in the inflamed part.

In inflammation the redness is usually caused either by the flow of an unusual quantity of blood into the part or by the admission of the red corpuscle of the blood into vessels which do not usually carry them, or in which they will not circulate without becoming obstructed, thus of the conjunctiva, or any other tissue which is colorless when healthy, becomes ~~bloody~~ inflamed its vessels soon become apparent though previous they were not seen. Although the redness of an inflamed part has been so often noticed

and described, its causes was long one of the disputed points of pathology, some observers insisting that it was due to the formation of new blood-vessels, while others argued that there was only a dilatation of those vessels that previously existed. Mr John Hunter in order to settle this question tried the following experiment by freezing the ear of a rabbit and thawing it afterwards, he found considerable inflammation developed in the ear, he then killed the animal and injected

both the healthy and inflamed ear, he found precisely the same vessels ramifying through both ears, but in the inflamed ear the arteries were much more distinct and enlarged than they were in the healthy ear.

The enlargement of the vessels of an inflamed part effects equally its arteries, veins, and cappilaries, and often extends to some distance beyond the focus of the inflammation. The amount of enlargement in the vessels of an inflamed part is not always the same.

From the observations of modern observers, it also seems that in addition to the enlargement there is a change in the shape of the blood vessels from the circumstance that they are seen to be thrown into curves that are more or less wavy & tortuous

From the microscopic examinations of Williams, Warton and others, we have also been shown that the red color of an inflamed part is not only due to a change in the calibre and arrangements of the vessels, but also to a change

of the position of the elements of the blood, and especially the condition of the red and white corpuscles. In health the red corpuscles of a transparent structure as the web of a bats wing or frogs foot, can be seen circulating with rapidity in the centre of the vessels whilst on each side may be seen the white corpuscles and liquor sanguinous, which circulates at a slower rate. But it is said that as soon as inflammation is developed, a change can be noticed, the red

corpuscles begin to retrograde, then to oscilate in the vessels, & the corpuscles adding to the color of the tissue which is inflamed. It is obvious therefore that the obstructed vessels become full of red as well as white corpuscles, which cause the bright-red color of the tissue which is inflamed.

Paget states that another cause of the increased redness of the inflamed part, is the oozing of the coloring matter (hematine) of the blood corpuscle, both into the interspace of the

areolar tissue. From these sources it is therefore shown that the red globules of the blood are the chief agents in producing the redness of inflammation.

The red color of a part when above the natural standard is generally regarded as evidence of inflammation especially if it is accompanied by any other symptoms, as heat, and swelling but redness alone is not a positive sign of inflammatory action, blushing causes it, and exercise produces congestion, yet neither would justify

the physician in thinking that the part was inflamed, simply because the colour was above the normal standard.

The increased heat of an inflamed part is another prominent symptom, but although marked the heat of an inflamed structure is not so much above the natural standard as the sensation of the patient or physician might lead to think to suppose, it being seldom above that of the centre of circulation at the heart of the patient.

John Hunter performed numerous experiments to determine this point, and he never found the temperature of an inflamed part raised above that of the interior of the body. He found that by blistering the chest of a patient that there was not more than one or two degrees difference between the heat of the inflamed part and that surrounding it, but on applying a blister to the extremities, which in consequence of their distance from the heart, are naturaly colder and

he found that the temperature of the inflamed part was between five and seven degrees higher than they were previous to applying the blister.

Although there was an increase of five or seven degrees higher he did not find that the heat was any greater than in parts near the heart. From the experiments of Hunter and the observations of others, we may infer that the actual increase of heat in inflammations of deep seated parts, is slight

probably not more than one degree and that in superficial parts or at the extremities it rises six or seven degrees, but in all instances it is not above the heat of the heart, thus showing the liability of being deceived by the sensations of a patient when the action of his senses are modified by disease.

The causes of the increased heat in an inflamed part have been differently explained by different authors on the subject. Hunter attributed it to an increased flow

of arterial blood to the part, raising the temperature to nearly that of the blood at the heart, while Liebig thinks that it is caused by the greater number of red corpuscles being introduced into the vessels, these corpuscles being as he supposed, oxygen carriers and thus causing the production of heat by chemical action in the inflamed part, And as Liebigs explanation corresponds with the opinion of some of our best physiologists on the production of vital heat, we have good reason in the present state

of our knowledge to regard it as being correct.

The development of pain by inflammatory action is probably due to the functional disorder of the nerves of the part, or sometimes the presence and confinement of the liquid products of inflammation, or the distension of the tissues produced by congestion in its blood vessels.

As a symptom of inflammation, the presence of pain should always be cautiously examined, as neuralgia or the simple functional

derangement of a nerve
may cause intense pain
without there being any
inflamation in the part,
and consequently its diag-
nosis becomes a matter of
importance. Generally
a neuralgic pain may be
distinguished from pain
caused by inflammatory
action in a part by the
fact that pressure relieves
the former, but augments
the latter, and neuralgic
pain may last several
days without developing
any of the results of inflam-
mation, especially suppuration.

which soon becomes appa-
rent when inflammatory
action has really taken place.
While the general sensibility
is increased by inflam-
matory action, the
special sensibility of
each particular organ
is diminished, and the
location of the pain is not a
sure sign of the locality of the
inflammation, for the
pain is often felt in parts
remote from the real seat
of the disease, thus inflam-
mation of the hip joint
is generally first shown by
pain in the knee, and

inflammation of the liver is often first indicated by pain in the shoulder, nor is pain strictly essential to inflammation, although it is so frequently present, for instances have been known where severe inflammation has existed without there being any pain to indicate its presence

The swelling which attends inflammatory action is liable to the same diversities as the other phenomena. The swelling is generally the result of mechanical distension of the tissues near

the seat of the inflammatory action, and is due either to the congestion of the blood vessels of the part or to the various effusions consequent on the disease. The situation, form, and degree of the swelling depends to a great extent on the natural structure of the part inflamed.

In serous membranes there being comparatively few vessels, there is but little enlargement, and the structure being dense, the effusions are not retained but overflow externally and collect in the most dependent part of

the sack, consequently causing dullness on percussion and after fluctuation in the chest and abdomen.

The mucous membrane is more vascular and complex in structure and the enlargement of the vessels causes some thickening, but the swelling is due to interstitial effusion into the submucous tissue.

The kidneys, liver, lymphatics and other glands, often attain a large size from distention of their blood vessels, effusion often take place in their structures, which by

different proportions of serum and lymph, causes swelling of different degrees of firmness.

The lungs, when inflamed do not increase in bulk but the effusions fills the air cells and thus increases the weight, and if the effusion abounds in lymph hepatization is the result.

The constitutional symptoms of inflammation are those which extend and effect the whole system. The functions of the entire body becomes more or less deranged, the pulse

becomes quick and hard, the arterial tonicity is increased, thence the capillary circulation is active, but owing to the tense state of the vessels and of the skin, the secreting organs do not act freely, the skin is dry and hot and the bowels are disposed to be costive

The most marked and important constitutional symptoms of inflammation are those changes which take place in the condition of the blood. There is an increase of fibrine and of the colorless corpuscles.

In all true inflammatory diseases, especially when it is of the sthenic character this state of the blood has been termed hyperplasma, or hyperinosis, it is by the separation and contraction of the fibrine that produces that peculiar buffed and cupped appearance of the clot so remarkable in inflamed blood.

This change in the blood is produced in the blood-vessels of the inflamed part, as is shown by the fact that blood drawn immediately from an inflamed part is more

buffed than that drawn from a part distant from the seat of the inflammation

Of the constitutional symptoms, next in importance to the changes in the blood is the phenomena of inflammatory fever. This fever sometimes precedes the local inflammation and is merely a general excitement or reaction after the influence of the disturbing or exciting cause, as where the inflammation is produced by cold, fatigue, or any of those other causes which first

produce congestion.

These causes generally first depress the whole system the pulse becomes weak the extremities and surface are cold, and the patient is depressed both in body and mind. This constitutes the cold stage of the fever. When the reaction commences the pulse and breathing becomes accelerated, the skin becomes hot, uneasy feelings in the head, back, and limbs, are experienced, also loss of appetite, thirst, restlessness and weakness

In the young and

plethoric patient the fever accompanying inflammation is generally of high character, attended with hot skin, hard pulse, and general excitement. But in those persons who are weak from age, malnutrition, disease, intemperance, or confinement in poorly ventilated apartments, the fever is generally of a low form, which is characterized by a weaker though sharp and quick pulse, less general heat of the skin, foul tongue, and the functions rather oppressed

or disordered than excited.
The character of the fever
also varies to some extent
with the seat of the inflam-
mation, and the particular
texture inflamed. It has
been commonly stated in
inflammations of serous
and fibrous textures and
in phlegmonous inflam-
mations of cellular textures,
the fever is of a higher grade,
and in inflammations
of the stomach and in-
testines, kidneys, and in
diffused inflammation
of cellular texture it is of a
lower form, and that in

inflammation of mucous membranes the fever is of an intermediate character. Experience has however shown that there are many exceptions to these statements and that where the character of the fever is effected by the tissue, it is chiefly by the intensity of the inflammation and also the nature of its products.

The inflammation which occurs after accidents or burns, and when the inflammation is caused by poisons which are locally irritant, and at the same

sedative to the system is often attended with a low fever, the reaction being imperfect from the continued depressing influence of the cause. The fever may be remittent or intermittent in the lower forms of inflamation, characterized by a state of depression, alternating with a period of excitement which ends in perspiration, and then again when the inflammation has become chronic, or where it is of slight intensity there may not be any fever excited at all, but generally

inflammation induces some constitutional derangement.

Inflammation is generally said to terminate in resolution, effusion, suppuration, or gangrene, But it would be better to say that inflammation terminated in resolution only, and that effusion, suppuration, and gangrene were the results of inflammatory action.

Inflammation is said to terminate in resolution when there

is a subsidence of the determination and obstruction of blood in the part, when any effusion that has taken place is removed, and the vessels contract to their usual dimensions.

Inflammation may result in resolution spontaneously in slight cases, or in consequence of treatment, or from inflammatory action springing up in another part. When resolution takes place there is a subsidence of the chief symptoms of inflammation, usually

the heat first gives away and perspiration commences, the pain becomes easier, the redness fades away and the swelling subsides as the effused fluid are removed by absorption.

The resolution is marked by the fever becoming ~~tranquil~~, the pulse becoming less frequent, the skin moist, and the urine becomes more copious which when analized is found to contain a large amount of urea and lithate of ammonia, this last

change being so constant a symptom of the decline of inflammatory fever has led some to suppose that it is critical, and determines the removal of the disease.

Effusion is one of the most common results of inflammatory action, the effusion is generally at first a thin serum, causing swelling in different structures, accumulating in the dependent parts of serous cavities or diluting the secretions of the more simple mucous membranes.

In acute inflammation of serous membranes, beside the effusion of serum, there is an exudation of fibrine or coagulable lymph, which is first in a semifluid state, but afterwards becomes thick and organizable is apt to produce adhesive inflammation if not removed.

The lymph which is thus effused is transparent, but afterwards it becomes more or less opaque and of a yellowish color. Healthy lymph is very susceptible of organization, which is designated by the term emplastic.

Thus lymph as it is effused possesses living properties, and the materials are found to arrange themselves into the basis of a texture, and in order to sustain the life of this texture there are blood vessels formed in it which communicate with the vessels of the adjoining parts.

When the inflammatory action is of a lower grade, the products are not so capable of organization, and hence it is called cacoplastic.

In other cases more or less of the products of inflammation is incapable

of organization and is consequently called aplastic.

At the beginning of an inflammation its products may be plastic, and the organization of blood-vessels may commence. If this inflammation is continued beyond a certain period its products are either thrown beyond vascular communications or displaces that which has already been effused, and thus the outer layer will be in a degenerating condition.

Suppuration is

another important result of inflammation, it is a work of destruction, and therefore may to some extent be contrasted with effusion of lymph which is intended to be a process of construction, or reparation.

Pus which is the products of suppuration is not a secretion, it is dead blastema, which when it is thrown out it is of low vitality and by the action of air, or heat, the formation of pus is promoted. Pus is an opaque, greenish, or yellowish white liquid of about the

consistency of cream, it consists of a clear fluid portion or liquid pus - in which float innumerable minute granular corpuscles. The symptoms of suppuration are local and constitutional. Locally the occurrance of suppuration is marked by a diminution of the heat, pain, and most of the other signs of irritation. The swelling becomes softer, and if it can be reached it is found more yielding under the fingers, and presents symptoms of fluctuation.

The redness is also

diminished, being superceded by a pale yellow color caused by the purulent effusions in the central part of the suppurating mass.

In external inflammation the redness on the surface becomes deeper before suppuration, but as soon as this process reaches the skin, a pale spot is seen which presents symptoms of fluctuation indicating the approach of the abscess to the surface.

The constitutional symptoms are marked by the lowering of the inflammatory fever, loosing its strength,

the redness being succeeded by paleness or a hectic flush, the heat subsiding, or alternating with chills and sweats, the excitement giving place to weakness and exhaustion, and a deposit of pale sediment in the urine.

These symptoms will vary with the extent of the suppuration, and the importance of the part affected.

Ulceration as it is an important result of inflammation, has long been a subject of various definitions and explanations

some of which have served more to confuse than to render the subject plain and intelligable.

Ulceration is that process by which a solution of continuity takes place in a part by a destructive absorption of a portion of the tissue of which it is composed. This I think is a correct definition of ulceration, I shall proceed to notice such general phenomena and vital action as appear to be intimately connected with it. We always see in an ulcer, or in the ulcerative process

whenever it may be that a portion of the tissue is gone, the part has not been cast off in the form of a slough, nor has it been removed by accident. We say that the excavation has occured by a destructive absorption, and mean by the expression that the particles of which the part is composed have been gradually removed as they have become worn out by the absorbants and capillaries of the return circulation while the supply by the arterial side has interfered with. Thus it is

easy to see that destruction must results when this is the case. This fact is beautifully illustrated by nature when she establishes the line of demarcation between the living tissue and the dead in cases of mortification. At first there is observed a bright red line which maps out the part which is to be cast off from the living portion, this line will always be found to include as much of the suffering part as nature is not capable of restoring to its natural healthy action

and no farther. This line is soon seen presenting the appearance of a groove, a portion of the tissue along this line has been removed by ulceration absorption, but none of the mortified portion has been taken for nature always true to herself does not inflict injuries and this line is thus established that she may get clear of the incumbrance of the portion that is dead and protect that which is living. The same principle is illustrated in cases of large phlegmons, where nature instinctively com-

mences the operation of evacuating the contents after suppuration has taken place. The arterial supply to the tissues which covers the phlegmon has been interrupted, but not sufficiently to occasion death of the part, though nutrition is mostly cut off while the return circulation has been permitted to go on. Thus the particles have been gradually removed and none brought to supply the vacancy, and finally the covering becomes so thin and delicate that the pus which is beneath

breaks the continuity and is evacuated.

It is a well established fact that all parts of the system are undergoing a constant change, that particles which form a portion of tissue to day will form no part of it tomorrow. Then it is not reasonable that when ever we get inflammation in a part just sufficient to interrupt nutrition, but not to cause actual gangrene, that there must be molecular death in the part; The tissues are worn out or wasted away, and

we say that destructive absorption has taken place.

Gangrene is not an uncommon result of inflammation. The circumstances which cause inflammation to terminate in gangrene are those which suspend the circulation of blood in the part so completely as to destroy the vitality of that portion of the body and where by the inflammatory proces the vital properties of the blood is destroyed.

When an external part becomes gangrenous

it loses all feeling, and other vital properties, it changes to a livid, or greenish, or almost black color, the cuticle rises in blisters on it, and there is an effusive odor exhaled from the part.

In external parts and those which communicate with the the surface, the odor which is exhaled from the part becomes a marked physical sign. In cases of gangrene of the lungs the odor is communicated to the breath and matter is expectorated, and in some cases the fetid odor is ex-

baled with the perspiration
from the whole body